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Some ten years ago, the Society for the Promotion of Engineering Education appointed a committee to make a comprehensive study of the situation, and this committee associated with it delegates from the five great national engineering societies. This joint committee has been cooperating with the Carnegie Foundation in this study, and the bulletin just issued is the result of their united labors for the past four years. The bulletin was prepared by Dr. Charles R. Mann, formerly associate professor of physics in the University of Chicago, now chairman of the advisory board to the War Department committee on education.

The origin of the present system of engineering schools is traced in detail and its characteristics, both good and bad, are frankly stated. Its operation is studied mainly from the point of view of the effect upon the student and there is a careful examination of entrance records and college courses, as well as a brief summary of the current methods of instruction. On the basis of this analysis of the present situation, the larger problems of engineering education are considered to be those of admission, content and courses, faculty organization, and curriculum. The treatment culminates in a definition of each of the larger problems in terms of the requirements of the profession and of the young men who wish to enter. The chapters on admission and on testing and grading describe a series of new and original experiments carried out by Professor E. L. Thorndike, of Columbia University, in an effort to secure a more rational method of measuring engineering ability.

The constructive portion of the bulletin presents numerous suggestions as to ways and means of solving the problems thus defined, in an effort to reach the general principles which seem best qualified to help each school in solving the problem according to its own peculiar circumstances. Among the suggestions may be mentioned the necessity for more objective methods of rating and testing students and more accurate records of achievement; the need for closer cooperation among the several departments of instruction at each school; the

introduction of practical experience with engineering materials into the freshman year; and the increase in the emphasis placed upon the humanities and humanistic studies.

The final chapter, entitled "the professional engineer," presents the results of an extended study of the demands of the engineering profession, and indicates that these demands can be fully met by the application of the principles that are developed in the preceding chapters. The thesis is set up that the chief lack in engineering education is the failure to recognize the importance of values and costs in all engineering work and suggests ways and means in which this idea may be emphasized to advantage both in the technical and the humanistic work. Engineering education is here shown to be but one branch of all education, and it is suggested that the methods of improving both are identical. Therefore, the bulletin has a wider interest than its title would imply and may be read with profit by educators of all kinds.

Copies of the Bulletin may be had by addressing the Carnegie Foundation, 576 Fifth Avenue, New York City.

TWO NEW ANTHROPOLOGICAL JOURNALS

DURING the present year two new anthropological journals have made their appearance—one devoted to physical anthropology, the other one devoted to American linguistics.

The establishment of the *American Journal of Physical Anthropology* is due to the energy of Dr. Aleš Hrdlička, curator of the division of physical anthropology in the United States National Museum. Up to the present time two numbers have appeared, which indicate that the scientific standard of the *Journal* will be a high one. The first number is introduced by a preface, and a general survey of the scope and aims of physical anthropology, both written by the editor Dr. Hrdlička. In the second number the editor gives a brief review of the history of physical anthropology in America. The department of literature is very full and exhaustive and gives a review of

all important publications that have appeared recently.

The second journal, *The International Journal of American Linguistics*, is edited by F. Boas and Pliny E. Goddard, with the assistance of Professor Uhlenbeck, of Leiden, and Dr. W. Thalbitzer, of Copenhagen. The first number of the journal contains a brief introduction setting forth the object of the journal. Special articles which have so far appeared deal with the languages of Central America and North America. In the reviews a summary of work done by the Bureau of American Ethnology is given.

F. B.

SPECIAL ARTICLES

THE RELATION OF THE PLANT TO THE REACTION OF THE NUTRIENT SOLUTION

ONE of the important factors to be considered in plant nutrition studies is the reaction of the nutrient solution. The determination of H ion concentration is of value, not only because of its general relation to plant growth, but also because of its bearing on the nature of selective absorption of ions. At the present time various misleading statements exist in the literature with regard to these points. In many cases principles which are elementary to the physical chemist have not been sufficiently appreciated by the agricultural chemist. In the course of extended studies conducted by this laboratory to determine some effects of concentration of the nutrient solution on plant growth and absorption, opportunity has been afforded for ascertaining the exact reaction of the nutrient media under widely varying and carefully controlled conditions. The purpose of the present article is the discussion in a preliminary way of this phase of the investigation.

It is a quite common impression that the plant by selective absorption may so alter the reaction of the nutrient solution as to produce extreme alkalinity or acidity. For example, Palladin¹ in describing water culture experiments states:

¹ Palladin, W., "Pflanzen physiologie," Berlin, 1911, p. 82.

Während der Vegetation muss dafür gesorgt werden, dass die Kultur flüssigkeit nicht alkalisch wird. Zur Beseitigung der alkalischen Reaktion wird so lange schwache Phosphorsäurelösung zugesetzt, bis die Lösung schwach sauer reagiert.

Also it is often claimed that from KCl, K₂SO₄, and similar solutions the cation is removed at a rate so much faster than that of the anion that a marked acid reaction ensues, which may result in injury to the plant. Conversely a NaNO₃ solution is said to become alkaline. The evidence on which these ideas are based is very slight. Some of the experiments quoted were performed many years ago, when chemical methods and principles were in a relatively imperfect stage of development. The condition of acidity or alkalinity in most of the investigations has been measured by various titrations, which for this purpose are subject to misinterpretation, as pointed out in a previous article.²

In the latter investigation experiments with barley seedlings indicated a strong tendency on the part of the plant to change the reaction of various potassium phosphate solutions in the direction of neutrality; either acid or alkaline solutions soon attained a H ion concentration equivalent to approximately Ph 7.0, while neutral solutions remained unaltered in reaction. These experiments have now been extended to other solutions including complete nutrient solutions, and observations have been made at all stages in the growth cycle of the barley plant. Also several varieties of beans have been used. The experiments were carried out by means of sand and water cultures, which will be described elsewhere. It will suffice to state here that the technique was such as to permit of the production of normal, well matured plants. In every instance, without exception, nutrient solutions with an acid reaction reached an approximately neutral reaction after contact with the plant roots for varying periods of time. Even where plants were grown to maturity without change of solution, the neutral

² Hoagland, D. R., "Soil Science," Vol. III., No. 6, pp. 547-560, 1917.